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Serum albumin concentrations and oedema in the newborn

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SUMMARY Serum albumin concentration was measured in 195 infants of 25 to 42 weeks' gestation during the neonatal period. Concentrations were significantly lower in preterm infants, rising from a mean of 19 g/l at 26 weeks to 31 g/l at term. There was a 15% increase in albumin concentrations in the first three weeks of life. Oedema in the early and late neonatal period was common in preterm infants but correlated poorly with hypoalbuminaemia. Measurement of serum albumin concentrations in preterm infants either routinely or because of oedema is not clinically useful.

Subcutaneous oedema is common in the newborn, particularly in the preterm infant, and typically involves the dorsum of the hands and feet. It is seen as a normal finding in the first few days of life,[1] but if it is more extensive or occurs later in the newborn period it may prompt investigation. Because of the relation between colloid oncotic pressure and serum albumin concentrations,[2] the latter are commonly measured and even 'treated' if found to be low. Normal concentrations of serum albumin, however, are not well defined in the newborn. The aim of this study was to determine the normal range of serum albumin concentrations in newborn infants and examine the influence of gestation and age on these concentrations. We also wished to correlate concentrations of albumin with the presence and severity of subcutaneous oedema.

Methods

All infants admitted to Nottingham City Hospital Neonatal Unit between March and September 1985 were studied. The infants were locally born or transferred from other hospitals and included almost all infants below 35 weeks' gestation regardless of the presence of complications of prematurity. Infants from 35 weeks to term who were admitted for surgery, who required observation for transient tachypnoea or treatment for infection, or who had suffered appreciable birth asphyxia or trauma formed a selected group. Gestational age was determined from the mother's menstrual history, antenatal ultrasound examination, and neonatal assessment by external and neurological criteria.[1]

Measurement of serum albumin concentrations and assessment of subcutaneous oedema were carried out within 48 hours of birth (usually within 24 hours) and then at weekly intervals if the infant remained in the neonatal unit. Albumin was measured by the bromocresol purple dye binding method on serum obtained from capillary (heel prick), venous, or arterial blood, which was being taken for clinical purposes. If capillary blood was used the first drop was wiped away to remove any interstitial fluid that might contaminate the sample. Subcutaneous oedema was measured at five sites: dorsum of one hand and foot, shin, sternum, and sacrum, using an arbitrary analogue scoring system (Table (a)). The score at each of the five sites was then summed to produce an overall oedema grade (Table (b)).

Table *The assessment of oedema. The sum of the oedema score at five sites: dorsum of one hand and foot, skin, sternum, and sacrum produces an overall grade of oedema*

Table (a)

Oedema score	
0	No oedema
1	Minimal oedema
2	Obvious oedema
3	Pitting oedema more than 1 mm deep*

*Measured with a depth gauge.

Table (b)

Total score	*Grade of oedema*
0	No oedema
1–4	Mild oedema
5 or more	Moderate oedema
Oedema at all sites	Generalised oedema

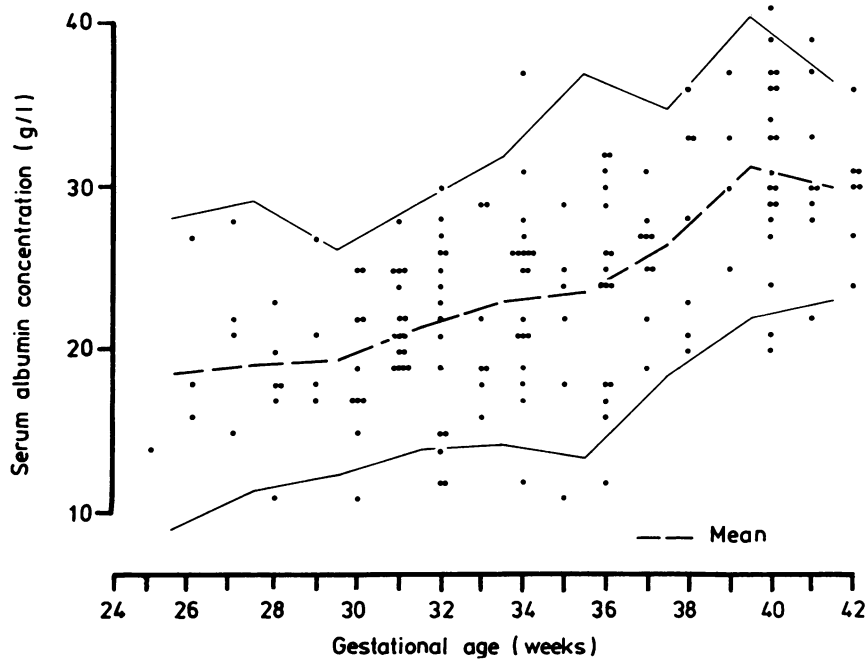

Fig. 1 *Concentrations of serum albumin during the early neonatal period in infants of 25 to 42 weeks' gestation. The mean and the 90% probability limits are shown.*

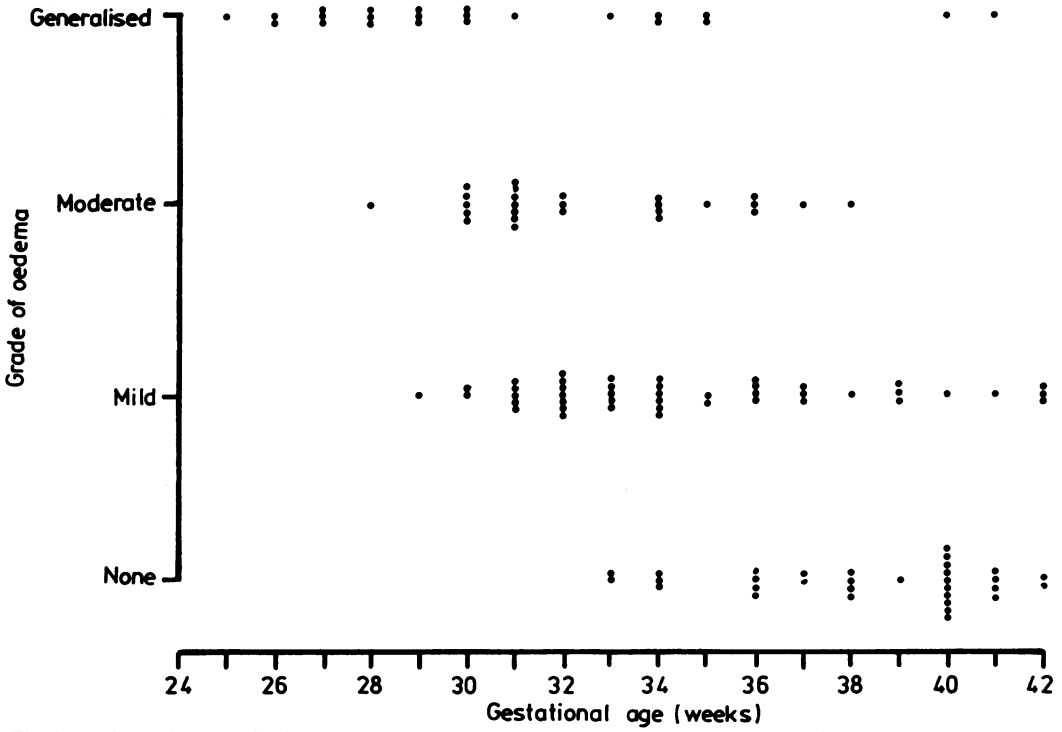

Fig. 2 *Relation between the degree of oedema in the early neonatal period and gestational age.*

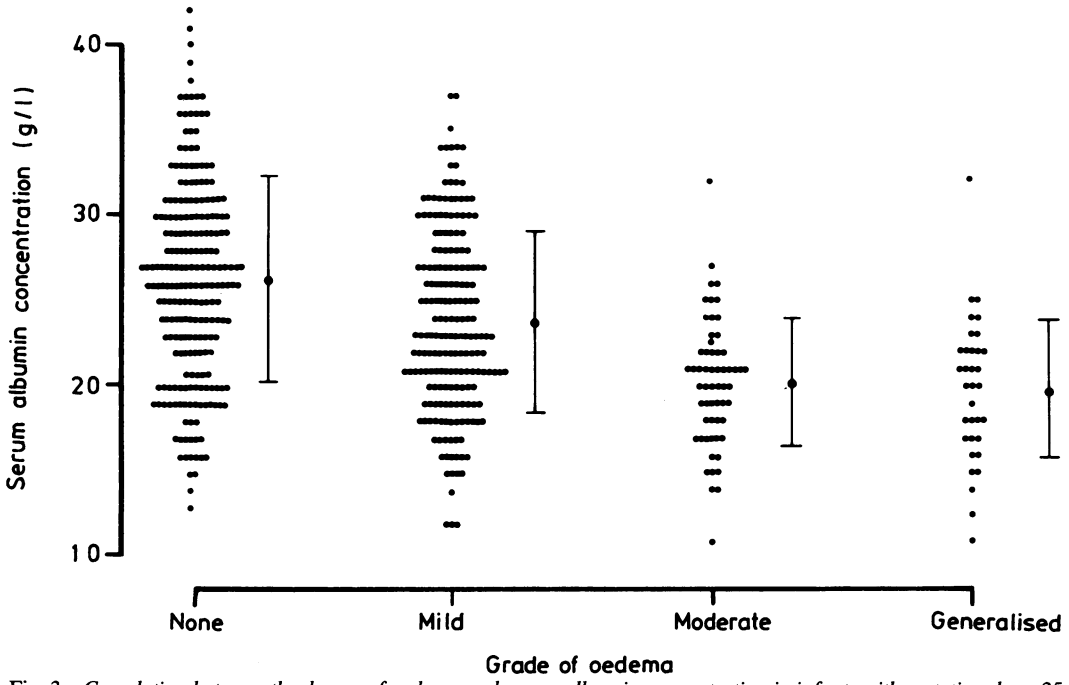

Fig. 3 *Correlation between the degree of oedema and serum albumin concentration in infants with gestational age 25 to 42 weeks and age range from 1 day to 27 weeks. There were significant differences between grades 0 and 1 ($p<0{\cdot}001$), 1 and 2 ($p<0{\cdot}001$), and 1 and 3 ($p<0{\cdot}001$).*

Subjects

Five hundred and ninety eight measurements of serum albumin concentration were taken in 195 infants, of which 549 were paired with measurements of oedema. The gestational age of the infants ranged from 25 to 42 weeks, birth weight from 640 to 5100 g, and ages from 1 day to 27 weeks. The study was approved by the hospital's ethical committee.

Results

Serum albumin concentrations in the early neonatal period increased significantly with gestation from a mean of 19 g/l below 30 weeks to a mean of 31 g/l at term (Fig. 1). There was a postnatal rise in serum albumin regardless of gestation—concentrations rising by about 15% in the first three weeks. The degree of oedema in the early neonatal period was inversely related to gestation (Fig. 2). It was common and often pronounced below 33 weeks' gestation but uncommon and mild at term. There was a significant inverse relation between serum albumin concentration and oedema (Fig. 3), but the correlation was poor. This was true when all measurements were considered and when early ($\leq$7 days) and late (>7 days) oedema were considered separately. In infants over 7 days old with a serum albumin concentration below the 90% probability limits only three out of 17 (18%) had moderate or generalised oedema. In comparison, of infants who had a serum albumin concentration within the 90% probability limits, 19 out of 123 (15%) had moderate or generalised oedema. There is no significant difference between these groups.

There was no relation between the nutritional state of the infant and serum albumin concentrations either at birth or 3 weeks of age. There was no relation between fluid or sodium intake and oedema. Two infants with trisomy 18 had pronounced generalised oedema with normal serum albumin concentrations.

Discussion

It has previously been shown that serum albumin concentrations increase with gestation,[3–6] but this is the first study to provide data on the normal range of serum albumin from 26 weeks' gestation to term.

There are two possible explanations for the rise. It is known that small amounts of albumin cross the placenta.[7] This transfer is probably greater towards term, as is the case with IgG immunoglobulin. Alternatively, the rise in serum albumin concentrations with gestation may be the result of increased synthesis by the fetal liver.[8] The small postnatal rise could be due to the contraction in extracellular water that occurs in the early neonatal period.

This study confirms the common finding of subcutaneous oedema, particularly in the preterm infant, in the early newborn period. Pronounced or moderate oedema was common in infants below 32 weeks' gestation, whereas term infants had no or mild oedema. This is one of the external criteria of assessment of gestational age used in the Dubowitz scoring system.[1] As both oedema and serum albumin concentration are related to gestational age it is not surprising that they correlate with each other. The degree of correlation is, however, poor, suggesting that oedema in the newborn is not caused by 'hypoalbuminaemia of prematurity'. The latter is a normal not a pathological finding. It is therefore very unlikely that infusion of albumin would have any effect on oedema and this study offers no support for its use in preterm infants. Indeed, if given as plasma protein fraction the extra salt load might increase the oedema. The incidence of oedema in preterm infants over 1 week old has not previously been documented. Although much less common than in the early neonatal period, oedema was present in moderate or pronounced degrees in 20% of infants below 36 weeks' gestation, mainly in those below 32 weeks' gestation. It showed no correlation with serum albumin concentration and did not seem to be related to sodium and water intake.

We conclude that measurement of serum albumin concentrations in preterm infants, either routinely or in the presence of oedema, is of little use in their clinical management.

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